REMARKS

Claims 1-3, 7, 8, 13-27 and 29-31 are pending. Applicants submit arguments for overcoming the rejections of the claims over the prior art of record. Accordingly, Applicants respectfully submit that the present application is in condition for allowance.

I. Claim Objection

In the non-final Office Action dated June 5, 2009, claims 29 and 30 were subject to objection based on the inconsistent use of units, °C and K.

Claims 29 and 30 have been amended to utilize "K" as the unit for temperature. No new matter was added; for example see Table 1 on page 12 of the present application, as filed. Thus, Applicants respectfully request removal of the objection.

II. Claim Rejections - 35 USC §103(a)

In the non-final Office Action dated June 5, 2009, claims 1-3, 7, 8, 13-27 and 29-31 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2001/0054457 A1 of Segal et al.

All pending claims of the present application require a tantalum sputtering target having a "non-recrystallized" structure. This term is clearly defined in the present application, as filed, on page 8, lines 4-23.

In direct contrast, Segal et al. disclose an aluminum-copper alloy sputtering target having a "recrystallized" structure. For example, see references to: a "fine and uniform structure" in Paragraph No. 0002; "grain size less than about 1μm" in Paragraph Nos. 0004 and 0035 and Claim 1; the "present invention provides a method for fabricating precipitate-free and ultra-fine grain targets" in Paragraph No. 0047; the "invention further contemplates the fabrication of

targets with fine and uniform grain structure" in Paragraph No. 0051; a "method for fabricating fine and stable grain structures" and the "billet after ECAE with dynamically recrystallized sub-micron structure" in Paragraph No. 0052; after "intermediate annealing EACE is repeated with the number of passes necessary to develop a dynamically recrystallized structure with the desired fine and equiaxed grains" in Paragraph No. 0058; and "a mechanism termed dynamic recrystallization occurs and promotes the creation of sub-micron grains in the structure" in Paragraph No. 0071 of the Segal et al. publication.

Accordingly, Segal et al. teach to one of ordinary skill in the art the application of equal channel angular extrusion (ECAE) (i.e. see apparatus for performing ECAE in FIGs. 11, 11A and 11B) and that ECAE is required to be conducted under conditions where "dynamic recrystallization" occurs. Thus, one of ordinary skill in the art is aware that the sputtering target prepared according to Segal et al. has a recrystallized structure (with fine and uniform grains of less than 1μm). Accordingly, Segal et al. certainly fail to disclose a sputtering target with a non-recrystallized structure as required by all pending claims of the present application.

Significant limitations recited by the claims of the present application are that the target is made of pure tantalum (not an alloy) and that the method of making the tantalum sputtering target provides the target with a non-recrystallized structure (which is the exact opposite of that taught by the Segal et al. publication).

With respect to conventional use of a recrystallized structure, see page 3, lines 7-13, of the present application, as filed, which states:

> "And, when performing sputtering, since it is said that the finer and more uniform the **recrystallized structure** of the target, and more uniform the crystal orientation thereof, a more uniform deposition is possible, and a film generating few arcings and particles having stable characteristics can be obtained. Thus, measures for making the **recrystallized structure** fine and uniform, and arranging it to be a specific crystal orientation are being taken ..."

The above described fine and uniform recrystallized grain structure sought by conventional thinking is precisely that taught by Segal et al. and is consistent with the teachings of the Segal et al. publication.

A detailed explanation concerning the "mechanism of recrystallization" is provided on page 3, lines 14-28, of the present application, as filed. Strain is accumulated within primary crystals due to plastic working. The strained primary crystals form a network cell structure with different orientations aggregated with lattice defects and are separated into a plurality of different areas with significantly differing orientations. When this kind of deformed structure is heated during a recrystallization annealing process, **first**, the cells transform into subgrains during a recovery process through a combination of transition and rearrangement, **and after the recovery process**, these subgrains combine, and a specific subgrain grows to become a recrystallized core. **Thereafter**, the recrystallized core corrodes the non-recrystallized portions, grows, and promotes full recrystallization.

However, the present inventors disagree with the conventional teaching concerning the requirement that the tantalum sputtering target have a recrystallized structure and teach the opposite to that taught by the Segal et al. publication. The present invention requires the sputtering target to have a non-recrystallized structure (which, of course, is the exact opposite of a recrystallized structure). For example, see page 7, lines 7-10, of the present application, as filed, which states:

> "... what is especially important in the present invention is to obtain a target material ultimately subject to plastic working such as cold rolling, or to refrain from conducting sufficient recrystallization so as to leave the processed structure **after the final processing step**."

As best stated on page 8, lines 1-2, of the present application, as filed, the final annealing step of the present invention simply alleviates warping of the target and does not recrystallize the

target. For instance, as stated on page 8, lines 4-5, of the present application, as filed, the structure of the target obtained is **a non-recrystallized structure and a processed structure remains therein**. A more detailed explanation is described on page 8, lines 12-20, of the present application, as filed, which refers back to the discussion concerning the "mechanism of recrystallization" initially discussed on page 3 of the present application. For example, page 8, lines 12-20, of the present application, as filed, states:

> "Although **recrystallization does not occur** ..., it is considered that the structure during the stage midway to recrystallization; that is, during the subgrain (recovery process) stage, occurs ... With these subgrains, the strain added to the object is absorbed in the primary crystals by the transgranular slip in a certain direction, the strain is accumulated therein, and the subgrains have a structure before the crystal growth separated into different regions in slightly different directions divided with a plurality of transitions in this strained primary crystal."

Accordingly, the "**first**" step in which cells transform into subgrains during a recovery process through a combination of transition and rearrangement occurs. However, the step **after the recovery process**, in which these subgrains combine and a specific subgrain grows to become a recrystallized core, does not occur according to the present invention. Of course, the further steps of permitting the recrystallized core to corrode the non-recrystallized portions, to grow, and to promote recrystallization also do not occur. As best stated on page 8, lines 22-23, of the present application, as filed, the present invention provides a tantalum sputtering target with "a unique structure having subgrains that is clearly different from a recrystallized structure".

Despite this clear structural difference between the claimed sputtering target and the sputtering target of Segal et al., it is stated in the Office Action that:

> "Segal differs from instant claim 1 because it does not specifically teach that the Ta sputtering target has a non-recrystallized structure. However, [0078] and [0079] of Segal teach the embodiment of **intermediate annealing** between extrusion passes at low temperature or just at the beginning of static recrystallization. Therefore, it would have been obvious to one of ordinary skill in the art to follow this embodiment of Segal to produce a Ta sputtering target

with a non-recrystallized structure in order to achieve a strong uniform texture (see [0079] of Segal)."

However, as correctly pointed out in the Office Action, Paragraph Nos. 0078 and 0079 disclose intermediate annealing steps, not final annealing steps. As discussed above, Segal et al. clearly teach that, after ECAE processing, the billet is additionally annealed (see Paragraph No. 0052) and that, as a result of the additional annealing, the high strength is obtained (see Paragraph No. 0052 and FIG. 2. Thus, Segal et al. relate to a means for ultimately obtaining a fine and uniform grain structure, and teaches-away from the formation of a final non-recrystallized structure. Further, Segal et al. fail to produce a sputtering target yielding the advantages offered by a non-recrystallized structure and one of ordinary skill in the art has no common sense reason or motivation for providing a non-recrystallized structure based on the teachings in the Segal et al. publication. Still further, it is clear that the technical concept of the present invention and that of Segal et al. are fundamentally different and direct one of ordinary skill in the art in opposite directions. One of ordinary skill in the art is simply not taught a non-recrystallized final sputtering target structure by the Segal et al. publication.

"Teaching away" is the antithesis of the art suggesting that the person of ordinary skill in the art go in the claimed direction. Essentially, "teaching away" is a per se demonstration of lack of obviousness. In re Fine, 873 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

As discussed above, Segal et al. teaches the ultimate production of a fine and uniform recrystallized structure (with a grain size of less than 1μm). Thus, one of ordinary skill in the art is clearly taught by Segal et al. to recrystallize the sputtering target during a final anneal. Accordingly, one of ordinary skill in the art following the teachings of Segal et al. would anneal the target structure so as to recrystallize the target structure. This is the exact opposite of that required by claims of the present application.

Accordingly, for at least this reason, Applicants respectfully request reconsideration and removal of the 35 USC §103(a) obviousness rejection of the claims of the present application.

In addition, it should be noted that while Segal et al. clearly require a process step of performing ECAE processing to from a dynamic recrystallized structure, the method claims of the present application do not require such a process step. Further, whereas the claims of the present application require the performance of annealing at a temperature that is lower than the dynamic recrystallization temperature in the final process of the entire production process of the sputtering target, Segal et al. at best introduce this kind of annealing as an intermediate annealing process step between passes of the ECAE process. Thus, the method claims of the present application are also clearly not obvious based on the disclosure of Segal et al. for at least this additional reason.

Still further, the claims of the present application are clearly directed to a high purity tantalum sputtering target, (not an alloy including tantalum). Also, see the limitations in claims 8 and 31 of the present application requiring a high purity tantalum sputtering target having at least 4N5 purity. In contrast, the overwhelming majority of the disclosure provided by Segal et al. is directly to an aluminum alloy having 0.5wt% copper. For example, see the description of FIGs. 2 and 4-9 in Paragraph Nos. 0020 and 0023-0028 and see Paragraph Nos. 0052 and 0068-0077 of the Segal et al. publication. Still further, see Paragraph No. 0053 of Segal et al. which discloses that "the invention provides ... high strength monolithic targets ... fabricated from ... **pure** aluminum, copper, gold, platinum nickel, titanium and their alloys". It is important to note the absence of a reference to a "pure" tantalum target in Paragraph No. 0053 as well as throughout the Segal et al. publication. The only minor reference to tantalum is in Paragraph No. 0004 which states that the target can include one or more of various metals and which identifies Ta

among a broad list of elements. Accordingly, Applicants respectfully submit that Segal et al. fail to provide a fair disclosure with respect to a sputtering target made of pure tantalum.

Also, with respect to claims 13-16 of the present application, Applicants respectfully submit that Segal et al. fail to teach the required hardness limitation with respect to a pure Ta sputtering target. As best demonstrated by the experimental data contained in Table 1 on page 12 of the present application, as filed, it is not obvious for a tantalum sputtering target to have the claimed level of Vickers hardness. For example, Comparative Examples 1-3 in Table 1 clearly fail to have the required hardness. Thus, Segal et al., which does not even disclose or discuss the hardness of a tantalum sputtering target, clearly fails to render such a limitation obvious or provide an enabling disclosure with respect to this limitation. Segal et al. is simply directed to a aluminum-copper alloy and fails to disclose anything relative to a pure tantalum target or how to avoid the outcomes experienced by the tantalum targets of Comparative Examples 1-3 of the present application.

Accordingly, the structure and production process required by the claims of the present application are different than those disclosed by Segal et al. and are clearly non-obvious relative to the disclosure of the Segal et al. publication. The technical concept of the present invention is clearly different to that disclosed by Segal et al., and whereas the present invention recognizes advantages offered by a non-recrystallized structure, in contrast, Segal et al. directs one of ordinary skill in the art to obtain a fine and uniform recrystallized structure (of a grain size of less than 1μm). Thus, Applicants respectfully submit that the claims of the present application are patentable over Segal et al. and request reconsideration and removal of the rejection.

III. Conclusion

In view of the above amendments and remarks, Applicants respectfully submit that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,
Howson & Howson LLP
Attorneys for Applicants

By /William Bak/
William Bak
Reg. No. 37,277
501 Office Center Drive
Suite 210
Fort Washington, PA 19034
(215) 540-9216